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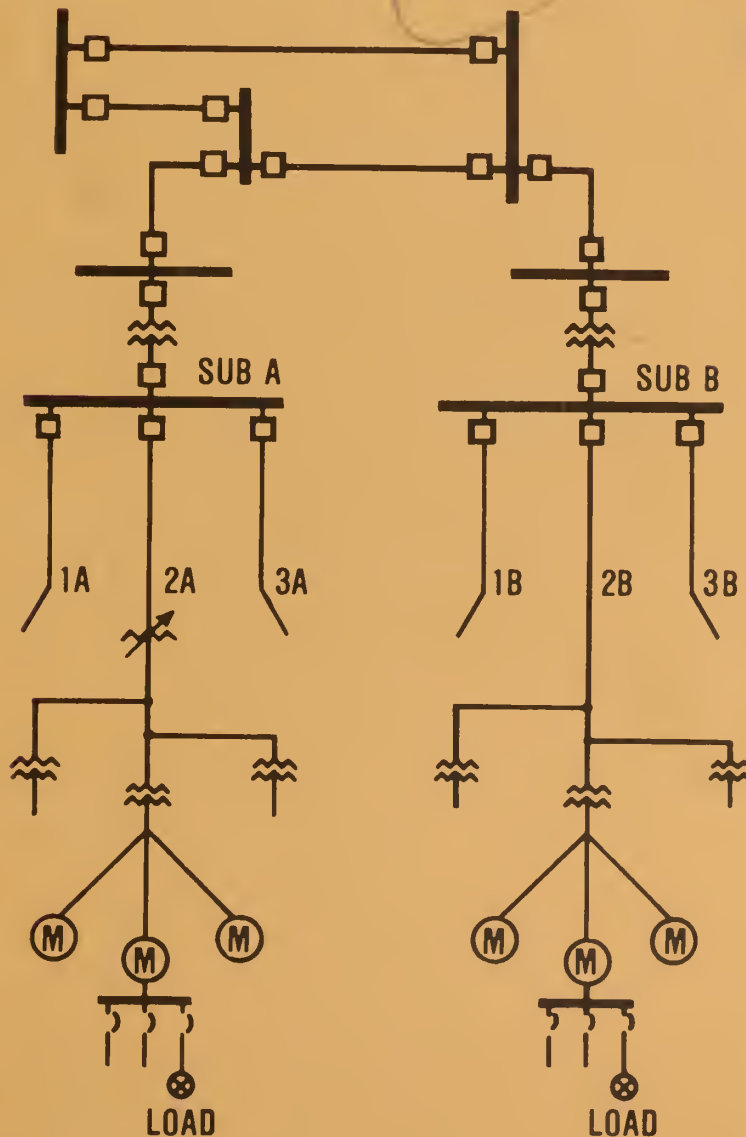
September 1981

Power System Communications: Guide Specification for Load Control Systems

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U.S. DEPT. OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION



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POWER SYSTEM COMMUNICATIONS⁴

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**Guide Specification for
Load Control Systems. --**

U.S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

FOREWARD

This Guide Specification has been developed to acquaint the REA Borrowers and their consulting engineers with the essential elements of a properly prepared specification for the procurement of a Supervisory Control System. It is not intended to be mandatory in structure but rather, it should be used as a tutorial tool and guide in determining what is needed.

It is incumbent upon the user to add, delete and modify as appropriate for the particular system to be procured in conjunction with specific Borrowers' requirements.



JOE S. ZOLLER
Assistant Administrator - Electric

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INTERNATIONAL SYSTEM OF UNITS

In December 1975, Congress passed the "Metric Conversion Act of 1975." This Act declares it to be the policy of the United States to plan and coordinate the use of the metric system.

The metric system, designated as the International System of Units (SI), is presently used by most countries of the world. The system is a modern version of the meter, kilogram, second, ampere (MKSA) system which has been in use for years in various parts of the world.

To promote greater familiarization of the metric system in anticipation of the U.S. converting to the system, REA is including metric units in its publications. This bulletin has, therefore, been prepared with the International System of Units (SI) obtained from ANSI Z 210-1976 - Metric Practice. Approximately equivalent Customary Units are also included to permit ease in reading and usage, and to provide a comparison between the two systems.

1.0 USE OF THIS GUIDE SPECIFICATION

1.1 Purpose

The intent of this bulletin is to provide an insight into the basic content requirements for the preparation of a sound, meaningful, and effective system design, engineering, and procurement specification for a Load Control System (LCS).

The Guide Specification is not intended as the solution for total system specification preparation; it is as the title suggests, an aid to those Borrowers who find it necessary to establish definitive specifications to be used by potential bidders. It is emphasized that the bulletin is not directive in nature; rather, its information and its purpose is to aid and supplement that information already available to Borrowers. In this regard, where the word "shall" appears, it is intended to represent the Borrower's expression to the potential bidder.

1.2 Scope

The Guide Specification covers each of the elements potentially requiring contractor assistance in the establishment of a Load Control System. This total system coverage permits the Borrower to use all or part of the content, dependent on support required. In addition to covering the various inter-related system elements, the guide provides methods for obtaining contractor or consultant response to Borrower requirements as well as technical specification outlines. This guide provides only the framework for a professional and effective specification, but does not obviate the need for definitive engineering data and professional engineering effort. Indeed, this guide is not intended to be a substitute for thorough system planning and detailed engineering and design. Users of this bulletin must recognize that a thorough knowledge of system requirements must be attained before the bulletin is applied and that this knowledge is a product of adequate analysis and engineering effort. The scope of these activities are not explicitly addressed but their necessity is presumed to be understood.

1.3 Application

As earlier indicated, the contents of the bulletin are designed to permit their use in whole or in part. The solicitation instructions and attendant data (Sections 2.0, 3.0 and 4.0) are pertinent to interface with potential bidders and/or with consulting engineers as requirements dictate. In effect, the bulletin content permits a "cut and paste" capability for initial preparation of the system specification framework. The word "framework" is used advisedly to emphasize the essentiality of engineering input to the final package.

Users of this bulletin are advised to be alert to the impact a specified parameter at one point in the system may have on a parameter value at another point in the system. Borrower Engineers or Consulting Engineers are the obvious source of the data necessary to fill the blanks. The fill data is the critical information which will insure that each element of the total system meets the parameters essential to system realization, construction, operation, performance, continuity, and maintenance. Firm, definitive data in the basic specification will insure that eventual contractors are technically and legally responsible for the desired results. Delays in system completion caused by insufficient or ambiguous data and the attendant discussions or renegotiations necessary with bidders or eventual contractors, can be avoided by thorough and professional preparation of the specification. It is reiterated that the Guide Specification is only as valuable as the engineering input to the specification. Proper use and application will greatly aid the Borrower in the timely development of a Load Control System, and serve to expedite any review and approval of the specification that may be required by the Rural Electrification Administration.

2.0 SOLICITATION INSTRUCTIONS AND NOTICE TO OFFERORS

2.1 You are invited to submit to (Cooperative Name) _____
(hereafter called the "Purchaser") your
proposal for the provision and delivery, F.O.B., to the
locations indicated, to include installation of equipment and
materials specified, which are to be part of the project
known as the _____ Microwave
Communications System, to be financed and accomplished via a
financing agreement between the Purchaser and the United
States of America (hereafter called the "Government")
executed by the Administrator of the Rural Electrification
Administration (hereafter called the "Administrator").

Sealed Proposals, to include separate Cost Proposals,
will be submitted as follows prior to _____ p.m., local time,
(Date) _____.

Original and _____ copies to:

Copy to:

Proposals received or postmarked after the specified
time and date shall be considered as "Non-Responsive" and
will not be considered unless:

- ° It was sent by registered or certified mail no
later than the _____ calendar day prior to
the date specified for receipt of offers
(e.g., an offer submitted in response to this
solicitation must have been mailed prior to
_____).

Acceptable evidence, as establishing proof of mailing
shall be the U.S. Postal Service postmark on the wrapper, or
Post Office receipt.

2.2 Any Subcontractor or Material Supplier furnishing either
equipment, materials or services under this project to a
Prime Contractor must obtain any drawings, specifications or
other documents relating to this project from its respective
Prime Contractor and not from the Purchaser.

2.3 All proposals, together with other supporting documents, must be submitted on the forms furnished by the Purchaser, delivered in sealed envelopes, addressed as indicated under Paragraph 2.1 supra, with the name and address of the Offeror clearly indicated on the outside envelope containing the proposal.

Proposals must be submitted in conformance with these specifications. Should an Offeror desire to propose alternate equipment, methods in lieu of those contained in the specifications, they shall be clearly defined, and as proposed, satisfy the project requirements, and be submitted as an alternate to the basic specifications. All costs associated with an Alternate Proposals, shall be clearly defined and furnished separate from those submitted for the basic specification requirements.

Any deviations, exceptions, or clarifications not treated in this manner shall be deemed non-compliant, and will not be considered.

2.4 The Offeror shall furnish with his proposal a complete set of specifications and typical drawings, including dimensions, design calculations and data, installation and maintenance instructions, operating characteristics, and such other information as is required to enable a thorough understanding of the equipment proposed to be furnished.

Unnecessarily elaborate brochures or other presentations beyond that sufficient to present a complete and effective proposal are not desired.

Elaborate art work, expensive paper and bindings, or other expensive visual presentation aids are neither necessary nor wanted.

2.5 Specific information to be submitted with an Offeror's proposal shall consist of the following:

- ° Radio path and equipment availability and reliability calculations
- ° Comprehensive description of the test methods and procedures for factory and field system tests
- ° A project schedule showing work flow and all major items or work, emphasizing critical project items
- ° Appendix A, Radio Equipment Design Data
- ° Appendix B, Site Survey and Data Summary Sheets
- ° Appendix C, Link Data/Design Summary Worksheets

- ° List of critical and recommended spare parts for all items of equipment furnished, to include unit pieces
- ° List of required or recommended test equipment, to include unit pieces
- ° Listing of systems of similar design, complexity and operation previously furnished and installed by the Offeror, with names of organizations or persons the Purchaser may contact relative to the same

2.6 Prior to the submission of the proposal, the Offeror shall make and shall be deemed to have made a careful examination of the plans and specifications and forms of equipment contract on file in the office of the Purchaser and with the Engineer, and all other matters that may affect the cost and the time of completion of the work.

2.7 Within _____ days of receipt of this request for proposals, all perspective Offerors shall notify the Purchaser of their intent to bid. This notice shall be addressed to:

If desired by an Offeror, arrangements for a pre-submission meeting with the Purchaser will be made to meet at the above location for discussion in reference to these specifications.

2.8 All proposals shall be signed by an individual authorized to bind the Offeror, and shall contain a statement that the proposal and Cost Quotations are valid for a period of not less than _____ days after the closing date to provide for proposal evaluation and resolution.

2.9 Any items which are clearly necessary for satisfactory performance shall be considered as part of the contract even though not directly specified. Such items should be noted by the Offeror and included in his proposal response.

2.10 Within _____ days after notice of award is given to the successful Contractor, a conference will be held in the office of the Purchaser for the purpose of discussing the details of the system equipment to be furnished and the schedule and manner in which the manufacturer's drawings are to be prepared and submitted. The Offeror shall have present at this meeting the project engineer responsible for this project.

2.11 Any exception to those specifications must be clearly indicated by the Offeror using the following format:

- a. Paragraph number
- b. Exception taken and reason
- c. Suppliers recommendations, substitution, or alternative

2.12 The contract, when executed, shall be deemed to include the entire agreement between the parties thereto, and the Offeror shall not claim any modification thereof, resulting from any representation or promise made at any time, by an officer, agent, or employee of the Purchaser or by any other person.

The Purchaser reserves the right to reject any or all proposals.

(Cooperative Name)

BY: _____

DATE

3.0 CONTRACT FORMS

The appropriate REA standard contract forms should be used. Usually, these forms will adequately express the intent of the parties to the contract. However, some modification of the standard form may be required in order to obtain the detailed description of services and work needed for a specific undertaking. When contemplating such changes, care should be exercised to prevent those changes from relieving the contractor of any of the responsibilities required of the REA standard form.

4.0 SCOPE OF PROJECT

This section should provide the qualitative information about the project that places it in clear perspective and, together with the detailed specifications, leads to as complete an understanding of the mission to be accomplished as practicable. This information should be in the form of a comprehensive summary that provides a general overview of the system, its objectives and requirements, equipment to be supplied, and a clear indication of the system's size and complexity. Information supplied should be concise, but at the same time, in sufficient depth to ensure the quality of bids to be received.

Clear functional information about the system should be included. Uncertainty about the functional requirements can translate into additional system costs because increased flexibility must be designed into the system. While flexibility may be desirable if it can be obtained at little cost, it is often costly in terms of available resources and obtained at the expense of other valuable features. Functional information about the system should include terminal and repeater locations, spur branching points, direction of information flow and the type of information to be transmitted, channel types and quality, compatibility with existing equipment and services, and capability for expansion.

5.0 LOAD CONTROL SYSTEM

5.1 General

This specification describes the functions required for unidirectional remote control equipment used for Load Control functions. Its design shall allow use, but not be limited to residential, agricultural, and commercial load control.

To insure responsive, reliable and secure signaling, encoded communications which conform to FCC regulations shall be used.

The load control system shall be of solid-state design throughout, except for current carrying contactors. The equipment supplied by the Offeror under this specification, shall employ proven state-of-the-art components and fabrication techniques.

5.2 Controllers

5.2.1 The control unit shall initiate the message required for any desired control function. The controller shall be capable of operating under manual control, automatic control, or selectively, by individual control functions.

5.2.2 The control unit shall provide the necessary logic and stored load control programs to allow control of remote switches by keying the load control transmitters. The control unit shall originate the content and frequency of command to manage loads as required. These parameters are input to the system using a keyboard with CRT display. Thereafter, the operation will be performed by the load control operator using the controller panel functions.

The controller shall be constituted so as to provide:

- ° 120 VAC \pm 10%, 60 Hz operation, 600 watts maximum
- ° Enclosure in desk style console or 19" rack
- ° Operator control panel, as required
- ° Crystal controlled, real time clock, to provide second, minute, hour, date, month, day of week and holiday (as programmed) status. Provide automatic initiation of up to _____ control schedules each with _____ periods
- ° Sequential control of message transmission of up to _____ transmitter groups

- ° Signal generation of discreet tone encoded or digitally encoded message formats
- ° Individual control of up to ____ control groups
- ° Load shed (SCRAM)
- ° External sensing for external control of control unit via SCADA, ADS, or other equipment
- ° Programs which can be modified at the end of each transmission sequence
- ° Programming accomplished with simple, intuitive parameters without need of extensive training in techniques
- ° Verification to prevent transmission of invalid messages and tones, for each transmitter
- ° Detection, selective disabling and indication of malfunctioning transmitters
- ° Provisions for maintaining program integrity in event of power interruption to ensure operation during peak periods
- ° Configuration using interactive English language via keyboard for specifying the following parameters:
 - Number of transmitter groups implemented
 - Length of message transmission interval
 - Load shed thumbwheel for switching interpolation tables
 - Minimum and nominal time-out characteristics of the control devices for each control group
 - Number of address groups in each control group
 - External contact assignment table
 - List of message formats (i.e., mark tone address command for discreet tone messages) comprising each control group
 - Dates of holidays for year

Assignment of schedules for automatic
operation to each control group

Entry of time and date for setting real
time clock

° Operate within specifications from - ____ °C to
+ ____ °C, with ____ % relative humidity,
non-condensing

5.2.3 A magnetic tape transport is to be provided for preserving and restoring variable parameters, facilitate the changing schedules as function of seasons, etc.

5.2.4 A control algorithm which automatically provides equitable distribution of specified load shed is to be implemented in the controller. The algorithm shall be general purpose, operating over any specified number of address groups, be capable of accommodating control devices with various time-out characteristics, and shall function independently of the hardware implementing the control functions.

5.2.5 Real time reporting is to be provided via the CRT. The reports will depict simulated status of control equipment. A report summarizing all equipment, as well as detailed reports for each control function shall be selectable by the operator. The detailed report shall contain current time and date status, elapsed time since last command for each address group, and percent contribution of load shed for the control group (to include interpolation during time-out period).

The report will contain current time and date, active/inactive indication status for each control group, load shed value selected, current load shed accumulated by each control group (with interpolation), plus index to last address group transmitted and number of messages last transmitted.

5.2.6 The central control unit shall provide for controlling each independent group for ____ to ____ minutes per hour for any period during the hour. These periods shall be cycled based on inputs to the control unit.

5.2.7 Any matrix design associated with the load control system shall be capable of expansion and display of up to ____ groups.

5.2.8 Provisions shall be made to either incorporate the demand data furnished by ____ into the CRT display or provide exterior recorders and mounting space within the console. CRT display is preferred. If exterior recorders

are used, they must be capable of being read to the accuracy required for load control operator actions without the operator leaving the console position.

5.2.9 Initiation of tone keying action shall be automatic once the load level reaches the preset level of value selected. Once the preset control level is set, program repetition (cycling) shall take place until either the peak drops below value set or is manually reset (may also be processor reset).

5.3 Switches

Two types of switches shall be required: Type I for insertion in the thermostat circuit of air-conditioners, and Type II for insertion in the heating element circuit of hot water heaters, and agricultural loads. Both types of switches are to operate upon receiving a correctly coded transmission. The unit shall interrupt connected appliances per command from the control unit. The switch unit shall provide a random return of appliances to operation to prevent current surge (current inrush) to the system.

5.3.1 FM Carrier Current Controlled Switch

The switch shall be of solid state design with conventional relay load contactors.

5.3.1.1 The receiver shall be capable of receiving FM carrier current tone modulated at _____ kHz frequency with _____ MV RMS minimum sensitivity with a time out circuit of _____ minutes \pm _____%.

5.3.1.2 The relay contactor shall be _____ pole, _____ throw, normally closed with contacts rated at _____ amperes, _____ VAC, _____ horsepower.

5.3.1.3 The relay coil voltage shall be _____ VAC.

5.3.1.4 The relay contactor shall be equipped with a non-resettable operation events counter for _____ digits.

5.3.1.5 The switch shall have an externally visible status indicator that is illuminated when the normal circuit is interrupted.

5.3.1.6 The switch shall provide for a cold load power-on sequence equal to _____ minutes, upon power restoration after a complete feeder or system power failure.

5.3.1.7 The power consumption shall not exceed _____ watts.

5.3.1.8 The contactor wiring connections shall be insulated pigtailed of _____ inches in length and _____ gauge tinned stranded copper with black for power and red for load interrupt.

5.3.1.9 The switches shall operate within stated specifications from - _____ °C to + _____ °C in a relative humidity of _____ % non-condensing.

5.3.1.10 The calculated MTBF of the switch shall be _____ hours using MIL-HDBK-217B method.

5.3.1.11 The switch shall be designed to withstand transient voltages in accordance with ANSI C37.90A-1974.

5.3.1.12 The switch enclosure shall be _____ inches high, _____ inches wide and _____ inches deep as per NEMA type _____ enclosure with hasp, color _____ finish, type _____, not to exceed _____ pounds in weight, and be suitable for _____ type mounting.

5.3.2 Radio Frequency Controlled Switch

The switch shall be of solid state design with conventional relay load contactors.

5.3.2.1 The narrow band FM receiver shall be of single conversion design, crystal controlled at _____ Mhz. The sensitivity shall be _____ uv, across _____ ohms measured at the antenna input terminal with a _____ kHz deviated signal. Spurious and image signals shall be rejected at a minimum of _____ dB below carrier level. The selectivity shall be a minimum of _____ dB at _____ kHz and _____ dB at _____ kHz. The receiver shall be FCC type approval Part 15. The switch shall have a time out circuit of _____ minutes, ± _____ %.

5.3.2.2 The activating code shall be field programmable for up to _____ codes, using two frequency, pulse width modulation (frequency shift keying).

5.3.2.3 The receiver antenna shall be mounted internal to the enclosure with provision for external antenna connection.

5.3.2.4 The switch shall be powered by _____ VAC and consume less than _____ watts during normal operation.

5.3.2.5 The relay contactor shall be _____ pole, _____ throw, normally closed with contacts rated at _____ amperes, _____ VAC, _____ horsepower.

5.3.2.6 The relay contactor shall be equipped with a non-resettable operation events counter with _____ digits.

5.3.2.7 The switch shall have externally visible status indicator which shall be illuminated when the normal circuit is interrupted.

5.3.2.8 The switch shall provide for a cold load power-on sequence equal to _____ minutes, upon power restoral after a complete failure.

5.3.2.9 The contactor wiring connections shall be insulated pigtails of _____ inches in length and of _____ gauge tinned stranded copper with black for power and red for load interrupt.

5.3.2.10 The switches shall operate within stated specifications from - _____ °C to + _____ °C in a relative humidity of _____ %, non-condensing.

5.3.2.11 The calculated MTBF of the switch shall be _____ hours using MIL-HDBK-217B method.

5.3.2.12 The switch shall be designed to withstand transit voltages in accordance with ANSI C37.90A-1974.

5.3.2.13 The switch enclosure shall be _____ inches high, _____ inches wide, _____ inches deep, weatherproof, gasket type screw-lock sealing suitable for _____ mounting and not exceeding _____ pounds in weight. The finish shall be weather resistant and _____ in color.

5.3.3 Ripple Current Controlled Switch

The ripple current controlled switches shall be of solid state with conventional relay load contactors.

5.3.3.1 The ripple receiver shall be capable of receiving ripple carrier at _____ Hz frequency with _____ MV RMS minimum sensitivity with a time out circuit of _____ minutes \pm _____ %.

5.3.3.2 The relay contactor shall be _____ pole, _____ throw, normally _____ with contacts rated at _____ amperes, _____ VAC, _____ horsepower.

5.3.3.3 The relay coil voltage shall be _____ VAC.

5.3.3.4 The switch shall have an externally visible status indicator that is illuminated when the normal circuit is interrupted.

5.3.3.5 The switch shall provide for a cold load power on sequence equal to _____ minutes, upon power restoration after a complete feeder or system power failure.

5.3.3.6 The switch wiring connections shall be insulated pigtails of _____ inches in length and _____ gauge, tinned, stranded copper with black for power and red for load interrupt.

5.3.3.7 The switch shall be equipped with an output relay memory such that after a power outage, all output relays are returned or maintained at the position ordered by the last control command.

5.3.3.8 The switch shall operate within stated specifications from - _____ °C to + _____ °C in a relative humidity of _____ % non-condensing.

5.3.3.9 The calculated MTBF of the switch shall be _____ hours, using MIL-HDBK-217B method.

5.3.3.10 The switch shall be designed to withstand transient voltages in accordance with ANSI C37.90A-1974.

5.3.3.11 The switch enclosure shall be _____ inches high, _____ inches deep and _____ inches wide as per NEMA type _____ enclosure with hasp, color _____ finish, type _____, not to exceed _____ pounds in weight and be suitable for _____ mounting.

5.4 Load Control Transmitter and Antennas

(Note to the Borrower: While the following listed types of communications mediums may or may not comprise the particular communications system applicable to your load control system, they are offered as typical examples on how the types of communications mediums listed could be specified.)

5.4.1 Load Control Transmitter

The load control transmitter shall provide the means of signaling the radio control switches located on the customer premises. The load control transmission equipment shall be configured for remote operation from the operator's position at the Control Center. The equipment to be furnished shall be provided with built-in test and metering facilities. Critical functions indicating the status and operation of transmission equipment shall be capable of being remoted using form "C" contacts. Critical operating and/or status functions shall be incorporated into the Alarm System for display at the control facility. The transmitter shall be capable of, and configured for, redundant operation.

The load control transmitters shall meet the following requirements.

- ° Frequency - _____ MHz \pm _____ %
- ° Temperature - - _____ °C to + _____ °C
- ° RF Power - Minimum _____ watts in _____ ohm load
- ° Spurious and Harmonics - More than _____ dB below carrier
- ° Modulation - FM
- ° Audio Distortion - Less than _____ at _____ Hz at _____ % deviation
- ° Power Input - _____ VAC, _____ Hz, Single Phase
- ° Transmitter shall be rated for continuous duty
- ° Dry contact alarm shall be provided for transmitter malfunction indicator circuits
- ° FM Noise - _____ dB below _____ % system deviation at _____ Hz

5.4.2 Antenna Systems

The antenna system requirements are critical to the successful operation and performance of the system. The Offeror shall review the _____ % area coverage requirements. He shall state the guaranteed system performance in terms of the service probability of obtaining the desired system coverage. He shall further correlate this service probability in terms of field strength, at constant contour intervals, from each of the sites.

If sufficient overlap between and among the two facilities exists, then each facility shall be served by a single load control transmitting antenna. It is imperative that the gain and antenna pattern proposed by the Offeror be the maximum possible, consistent with operating the load control system, on a non-interfering basis with other proposed or operating load management and load control systems in the area.

5.5 Transmission System

The transmission system shall provide the medium for activation and operation of Load Control VHF Transmitters, VHF/Power Line Carrier Hybrid Systems, or Ripple System Injection Units.

5.5.1 VHF Radio

The VHF radio transmission system shall consist of a load control VHF transmitter, VHF transmit antennas, VHF propagation loss, switch, VHF receive antenna and the load control switch.

The Offeror shall design the system such that the area served by radio load switches has a signal strength of at least _____ $\mu\text{V}/\text{M}^2$. The system shall be capable of passing encoded signals from the load controller to the radio switch with an availability of _____.____%, excluding power outages.

5.5.2 VHF Radio/Power Line Carrier Hybrid

The VHF radio and Power Line Carrier hybrid transmission system shall consist of a load control VHF transmitter, VHF transmit antenna, VHF propagation loss, transmission mode converter, VHF antenna, mode converter, low level power line distribution system, and the Power Line Carrier Load Control Switch.

The Offeror shall design the system in a manner that insures the area served by the transmission mode converters has a signal strength available of at least _____ $\mu\text{V}/\text{M}^2$. The power distribution system shall be modified by the Offeror to allow low level power line distribution to the load switches with minimal losses and efficient use of transmission mode converters.

The transmission mode converter shall consist of the following.

- ° Radio Receiver

The radio receiver shall be narrow band, dual conversion, with crystal controlled frequency at _____._____mHz, ± 0 .____%. Image rejection shall be at least _____dB down, with selectivity of _____dB minimum, at \pm _____kHz from carrier center frequency. The receiver shall be FCC type approved and be equipped with an internal VHF antenna.

- ° Decoder

The decoder shall be digital and have field programmable address of _____ through _____. Commands shall be from _____ to _____.

° Power Line Carrier Transmitter

The power line carrier transmitter shall have an output of _____ V peak-to-peak over _____ VAC power distribution lines at _____ kHz. The output connections shall be _____ wire _____ VAC as pigtails, _____ inches in length, of stranded, tinned copper # _____ guage PVC covered wire. Neutral shall be white in color while the other pigtails shall be black.

The housing shall be waterproof, suitable for pole mounting, with a maximum weight of _____ pounds, of _____ inches by _____ inches by _____ inches in size, and be constructed of molded, flame-resistant plastic resin.

The mode converter shall operate within stated specification from - _____ °C to + _____ °C, _____ to _____ % humidity non-condensing. The reliability shall exceed _____ hours MTBF as calculated using MIL-HDBK-217B. The transit voltage protection shall exceed ANSIC37.90A 1974. Power consumption shall not exceed _____ watts average power.

The system shall be capable of passing encoded signals from the load controller to the power line carrier load switch with an availability of _____ % excluding power outages.

5.5.3 Ripple Injection

The ripple injection transmission system will consist of a load controller interface, a communication link to the substation injection and coupling equipment, the low level distribution line system, and the ripple load control switches. The Offeror shall design the system in a manner that insures a ripple signal of at least _____ mV RMS at _____ Hz is received by each load switch in the load control area. The low level distribution system shall be modified as required to the level of ripple signal strength.

The load controller interface is described in Paragraph 5.2 and Communication Requirements are covered in Section 7.0.

5.5.3.1 Substation Injection and Coupling Equipment

The substation injector must be designed to operate under the following environmental conditions.

- ° Any transformers, reactors, or capacitors furnished shall be suitable for use in bulk-power transmission substations

- ° Maximum Temperature Rise permitted: for altitudes of _____ feet and less per ANSI-C57.12, Paragraph 7
- ° Altitude - approximately 5,000 feet above sea level
- ° Seismic risk zone per U. S. Department of Commerce Publication 41-1

Transformers or reactors used in the injection equipment shall meet the following specifications:

- ° All bushings supplied shall have mechanical and electrical characteristics in accordance with ANSI Standard C76.1-1964
- ° All bushings shall be wet-process porcelain
- ° Bushings rated 15KV and below may be of solid porcelain construction or condenser type
- ° The color of the porcelain shall be ANSI 70 gray
- ° All cover-mounted 69KV bushings shall be of the draw lead type where the maximum current requirements of the lead permits
- ° Bushings may be tilted to provide external or internal clearances, but bushings shall be symmetrically laced for good appearance
- ° As far as practical and L.V. bushings shall not be offset laterally from the H.V. bushings. Center phase bushings shall not be inclined laterally
- ° Pockets shall be provided for current transformers as required
- ° The bushings required for the transformers shall be rated as follows:

	<u>Voltage Rating KV</u>	<u>BIL Rating</u>	<u>Required Spacing, Inches</u>
Line terminals of 72KV windings	69	350	48
Line terminals of 25KV windings	25	150	30
Line terminals of 15KV windings	15	110	24
Neutral terminal	15	110	24

- ° Oil filled bushings shall have a liquid level indicator and means for filling, draining and sampling oil
- ° Bushing studs other than the neutral bushing shall be suitable for standard 4-hole spade terminals which will be furnished by the owner

Core and Coil Assembly

- ° Laminations shall be of a "non-aging" alloy
- ° Joints in the winding or bushing locations shall be brazed or compression spliced but shall not be soldered
- ° Insulation - the insulating material, varnishes and compounds in contact with the oil shall not affect or be affected by the oil
- ° Rigidity - Transformer assemblies shall be braced and bolted adequately to prevent displacement and distortion of the core and core assembly under all normal conditions of handling and operation, as well as under short circuit conditions
- ° Locking provisions are required on all inside bolted connections
- ° Serial number shall be stamped on the core in a conspicuous place

Radiators

When the transformer or reactor is provided with removeable radiators, the radiators shall be attached to the transformer with the necessary valves to permit removing the radiators without draining the oil in the transformer.

Transformer Reactor Oil

- ° The transformer shall be provided with oil in accordance with proposed NEMA Standard No. TR-P8-1975
- ° The transformer, when shipped, shall meet all existing Federal regulations to be classified as a non-PCB unit

- ° The transformer shall be provided with oil inhibited with ditertiary butylparacresol (DBPC). The amount of inhibitor in the oil shall be _____ and the transformer shall indicate that the oil is inhibited
- ° The Manufacturer shall draw a one-quart sample from each lot of oil before shipment and shall forward this sample immediately to the Purchaser for analysis

Oil Cooling System

- ° Cooling fans and pumps shall be suitable for operation from a single phase 240 volt 60 cycle supply
- ° A top oil liquid temperature indicator shall be provided, with alarm contacts adjustable in the range _____°C to _____°C. The indicator shall be located at eye level
- ° A hot spot winding temperature indicator, equipped with three (3) sets of contacts, shall be provided. The first set of contacts, to close at _____°C, shall initiate the first stage of cooling. The second set, to close at _____°C, shall initiate the second stage of cooling. The third set of contacts shall be adjusted in the range of _____°C to _____°C and shall be used for alarm. The indicator shall be mounted at eye level
- ° Two elapsed time meters shall be provided to indicate the total time each stage of cooling is in operation
- ° The control switch for the cooling fans and pumps shall have two positions which shall be labeled: HAND-AUTO. In the "HAND" position, all fans and pumps shall be energized. In the "AUTO" position, the cooling equipment shall be energized according to the demand of the temperature relays. There shall be no "OFF" position. The switch shall be accessible without opening cabinet doors.

- ° The cooling equipment control shall have an alarm contact to signal loss of power. It shall incorporate a time delay feature to block alarm on momentary loss of power
- ° If pumps are used in the cooling stages, there shall be an alarm contact to indicate loss of oil flow. The alarm shall have a time delay adjustable over a range of ____ to ____ seconds

Painting

All exterior surfaces to be thoroughly cleaned of mill scale and rust by shot or grit blasting. Oil or grease to be removed chemically. A suitable primer and finish coat of paint shall be applied to produce a high quality, long lasting coating. Minimum thickness shall be three mils. Finish coat to be per EEI Munsel Notation #5BG 7.0/0.4 light gray.

Control Cabinet

The control cabinet shall be provided with the following accessories:

- ° Door operated light
- ° Thermostatically controlled strip heaters
- ° Incoming AC and DC circuit breakers
- ° Duplex receptacle which is protected by a ground fault interrupter (GFI) circuit breaker
- ° Full-width hinged door with provisions for pad-locking and guides to hold the doors in an open position

The substation injector shall not produce an ambient noise greater than 50db as measured at the substation property line. The average sound level of the equipment shall not exceed 60db as measured by the NEMA method TRI-1974, Part 9.04.

In instances where signals are injected on Purchaser lines at points where they interconnect with other utilities, blocking devices must be furnished to provide for signal blocking on the foreign lines. Agreements must be obtained with the affected foreign utility to the effect that the signal will not effect their relaying, or other signaling, and that trapping will not have to be provided by the foreign utility to remove the signals.

Ripple load switches are described in Paragraph 5.3.3. The ripple injection transmission system shall be capable of passing encoded signals from the load controller to the ripple load switches with an availability of _____. ____% excluding power outages.

5.6 Frequency Coordination

The Offeror shall provide radio frequency coordination (via their UTC) with other adjacent users so that the new load control system will not interfere with their operations. This coordination shall take place and the related data submitted to the owner prior to the FCC license application actions.

5.7 Test Equipment

The Offeror shall recommend all test equipment necessary to assure proper testing and operation of the Central Control Console and Processor, Load Control Switches, and any communication equipment furnished under the Load Control/Communications project.

5.7.1 Facility Test Equipment

As a minimum, the following test equipment shall be furnished to perform the functions stated for the Load Control Center Control Console, Processor and Load Control communication equipment.

5.7.1.1 Logic Analyzer

A logic analyzer shall be furnished to troubleshoot and maintain the controller and its processor. The logic analyzer shall be capable of displaying _____ traces simultaneously, and recognize _____ bit words on _____ traces for the triggering of the analyzer. The analyzer shall be capable of displaying _____, _____, _____, data in _____, _____, _____ modes. The display shall be a minimum of _____ inches in height, and _____ inches wide. The analyzer shall be dolly-mounted and operate from _____ VAC.

5.7.1.2 Communications Analyzer

A Communications Analyzer shall be furnished to troubleshoot and maintain the load control transmitter. In addition, it will be used to verify RF sensitivity of the radio controlled switches and the Load Control VHF receivers and decoders. The communications analyzer shall operate between _____ and _____ mHz with calibrated output levels from - _____ dBm to _____ dBm, using narrow band FM modulation. The frequency stability shall be 0. _____% or greater.

The analyzer shall measure FM modulation up to _____ kHz of a received signal at - _____ dBm or greater. The analyzer shall be portable, and operate from either _____ VAC or an internal battery source when AC power is not available. The analyzer shall not exceed _____ pounds in weight, with internal battery included.

5.7.2 Field Test Equipment

Field test equipment shall be furnished to assist installation, the testing and maintenance of the load control transmitters and receivers, decoders, plus the radio FM current carrier, and the ripple load control switches.

5.7.2.1 Portable Transmitter

A portable transmitter, shall be furnished, which will transmit upon command, an address and command, that will enable field diagnosis and verification of equipment operation.

The transmission range shall be approximately 500 feet. Operation will be manual (i.e., single transmission of programmed message) or automatic (i.e., continuous transmission of message on approximately _____ second intervals).

A feature should be provided to allow power line carrier signals to be generated as well. Injection should be possible on _____ VAC and _____ VAC. Modes of operation should be similar to the operation in the radio frequency mode.

The transmitter unit will operate from _____ VAC, _____ VAC or an internal battery for portable operation.

The portable transmitter shall not exceed _____ pounds in weight.

5.7.2.2 Radio Frequency Field Strength Meter

A portable unit for evaluating the adequacy of radiated signal level shall be furnished. This device is to be used by personnel who may not be familiar with radio frequency technology and as a result, should be provided with a "go/no go" indication. Audio monitoring should be possible to assure the user that a test transmission is being sent. It will also allow the user to coordinate the measurement. The meter shall have a minimum RF sensitivity of _____ mV/M².

This device shall be portable, utilizing the same receiver and antenna used in the load control equipment. This will improve the correlation of indication and the confidence of proper equipment operation. The unit shall operate from _____, _____ VAC or an internal battery. The meter shall not exceed _____ pounds in weight, battery included.

6.0 MAN/MACHINE INTERFACE SUBSYSTEM

6.1 General

The man/machine interface at the operation center(s) is where the operator personnel interacts with the load control system, and the power supply sources for load management during peak demand periods. The operational control may be automatic by computer programs interactive with power supply sources or manual when source information is not available. The man/machine interface shall be designed to minimize operator induced error into the load control system as system security with a high degree of reliability and exhibit human factors engineering as a high level of interaction between machine and man with minimized operator training requirements.

6.2 Console

The primary system console(s) shall be capable of showing the load control system operational status along with power source load demand information. The load control shall be automatic by computer software that interacts with the power supply source demands. The operator shall be provided the capability to override the automatic load control at any time with the correct security code and manually entering/executing load control commands.

6.3 Console Configuration

The console shall be configured in a manner that provides for operator convenience in use and shall, as a minimum, house the following system elements:

- ° Controller Microprocessors
- ° Magnetic Storage Devices
- ° Operator Control Panels
- ° CRT and Entry/Control Keyboard
- ° Power Source Information Interface
- ° Command/Communications Interface
- ° Operator Position and Writing Shelf

The console shall be equipped with a flat writing space or shelf _____ inches wide and _____ inches long adjacent to the operator position and be surfaced with non-marring plastic laminates. The complete console shall not occupy more than _____ square feet of floor space with floor loading of _____ pounds per square foot or less. The height of the console shall not exceed _____ inches in height.

All equipment mounted in the console shall have front panel access for maintenance with rear equipment chassis plug-in cables equipped with safety latches. Any units that exceed _____ pounds in weight shall be equipped with detachable chassis slides for complete removal from console.

The console shall be of heavy-gauge metal construction designed to withstand _____% more attached unit weight than the maximum configuration.

6.4 CRT Display Equipment

The CRT display equipment will show system-wide control strategies, load status, control actions taken, control parameter values, system status and alarms, and other information pertaining to Load Control System operation. Inputs and modifications to system operation will not require computer programming. Load groupings and desired control actions will be defined, modified, added or deleted through interactive dialogue between the console and operator.

The CRT will display computer-generated information or information entered by the operator from a keyboard. The CRT displays will have the following:

- ° Automatic refresh, but hold the display for six seconds to permit the operator to observe data before it changes value
- ° Flashing capability for alarms and critical data values
- ° Cursor control which includes movement with a tab key or other method of rapid cursor movement

The keyboard shall be a standard keyboard layout with bounce-free contacts. In addition to the standard alphanumeric keyboard, an additional adding machine type 9-key keyboard shall be an integral part of the keyboard assembly.

6.5 CRT Monitor

The CRT monitor will be a minimum diagonal size of _____ inches. The CRT's will be single color minimum (white or green) raster type display devices. The character set shall include a 64 character ASCII alphanumeric and punctuation symbol set. Each character shall be randomly accessible, and capable of being individually set to a blinking or steady condition. The CRTs will be of industrial quality to provide improved resolution of displayed information. All maintenance adjustments and controls shall be accessible by Purchaser's maintenance personnel. X-ray emissions shall not exceed 0.5 milliroentgens per hour measured two inches from any point on the outside of the monitors.

6.6 Communications Facility

The communications facility consists of the interface with the power source and the load being managed. A means of alerting the operator of any interface failures by local or remote alarms.

6.7 Logging Devices

The logging devices of the load control system shall consist of _____ medium speed printer(s) at _____ characters per second minimum on an _____ character width print line.

6.8 Alarms

6.8.1 General

Offerors shall furnish all equipment necessary to make operational an alarm system for the purpose of monitoring the Control and Communication equipment. Each site shall be equipped with an alarm transmission system to transmit the system status at that station to a master station located in the headquarters communications facility.

6.8.2 Design

The alarm system requirement shall be of all solid state design. It may either be of the continuously monitoring type or the interrogating type. Fail safe operation shall be provided. Circuitry shall be mounted on plug-in cards or modules mounted in equipment shelves or card cages.

6.8.3 Remote Requirements

Remote terminals shall be capable of receiving alarm inputs for normally open, normally closed, supply voltage, or ground conditions.

The remote unit shall have capability of providing control outputs by addition of equipment only. Control outputs are not to be included in the initial system configuration.

Each remote terminal shall be equipped with the following features:

- ° Local display to provide front panel indication of each alarm input
- ° Alarm memory to assure that all alarms lasting greater than _____ mx will be transmitted by the remote unit

Remote terminals shall operate on a nominal -24 volt DC or -48 volt DC. Option shall be field selectable and shall be selected on the basis of the station power source.

6.8.4 The remote alarm unit shall be located in the unattended sites, and must be capable of continuous operation without corrective maintenance under the following conditions:

- ° Operating Temperature Range ___ °C to ___ °C
- ° Ambient Humidity ___% to ___%
 non-condensing
- ° Power ___ VDC to ___ VDC
 with ___ MV p-p
 ripple

6.8.5 Amplifiers employed in the transmit and receive paths shall be adjustable to control the baseband tone levels within the specification limits of the test tone levels established for the system.

6.8.6 Each remote unit shall be equipped with a baseband tone bridging scheme to permit multiplexing of tone channels directly to the baseband without the use of voice multiplex equipment.

6.8.7 The remote alarm units shall operate from a ___ VDC power source and transmit the status of a minimum of ___ alarm points. The remote alarm units shall be easily expandable to ___ alarm points. Offerors shall detail this expansion capability in his proposal.

6.8.8 Each remote alarm transmitter shall be wired to transmit the following alarms initially:

- ° Radio receiver failure (all major alarms connected in parallel)
- ° Radio transmitter failure (all major alarms connected in parallel)
- ° Building Hi/Lo temperature
- ° Loss of AC power
- ° Loss of battery charger DC output
- ° Hi/Lo DC voltage (paralleled)
- ° Illegal entry of radio building

- ° VHF or UHF radio failure
- ° Tower beacon lights failure
- ° Transmission line pressure failure

6.8.9 The transmission tone equipment used shall utilize a transmit and receive frequency in the _____ to _____ kHz band.

6.8.10 Master Requirements

The master station shall continuously interrogate in a sequential manner each of the remote stations, and report normal or off-normal conditions. The master station shall, as a minimum, include or display the following:

- ° Change of status
- ° Alarm status of each parameter interrogated
- ° Alarm disable to silence alarms from stations having intermittent alarms
- ° Indicate major or minor alarm

6.8.11 The master alarm unit and associated equipment must be capable of continuous operation without corrective maintenance under the following conditions:

- ° Operating Temperature Range _____°C to _____°C
- ° Ambient Humidity _____% to _____%
non-condensing
- ° Power _____ VDC to _____ VDC
with _____ MV p-p
ripple

6.8.12 Transmit and receive terminals must have at least _____ dB isolation. Spurious tones and harmonics that may be generated by either the transmit or receive equipment must be less than _____ dBmO outside of the operating bandwidth.

6.8.13 The master alarm unit shall operate from a _____ VDC power source.

The alarm equipment shall be connected to the communications system baseband, and operate in the _____ to _____ kHz frequency band. The transmit and receive levels and the impedances shall be compatible with the equipment proposed.

6.8.14 The master station, as installed, shall:

- ° Be capable of indicating the site from which the alarm is being sent, as well as the specific alarm nature, without the necessity for the operator to depress any decode or select button
- ° Have both visual and audible alarms
- ° Display the identity of any site which has transmitted a change of status signal since the last system check
- ° Display the identity of stations which are in failure due to tone transmitter failure or no modulation of the tone transmitter
- ° When manually selected, display the status of each of the alarm points at each remote site
- ° Provide a visual indication of code check confirmation from the selected station
- ° Provide an audible alarm indication that may be silenced or acknowledged from a location other than the master station cabinet
- ° Provide a method to allow audible alarms to be selectively silenced on one or more faults without affecting any other alarm(s) that may occur before a particular alarm is corrected

6.8.15 Alarm Security

Alarm tones shall be coded to prevent false reporting. The coding security scheme shall be explained in detail by the Offeror.

6.8.16 Indicators

A means shall be provided for checking visual alarms without removing indicators from the master or remote units.

6.8.17 Master Station Printer

A master station printer shall be furnished and installed to provide a hard copy record of all changes of alarm status occurring in the system. Printer shall have ASCII output ports.

6.9 Subsystem Expansion

The system shall have _____ consoles initially with an expansion capability for _____ more to be added in the future. The load controller shall have the capacity for controlling _____ load control switches initially with the expansion capability of _____ more load control switches to be added in the future. The additions shall be possible through minor additional hardware and software changes within the load control operation center.

7.0 COMMUNICATION REQUIREMENTS

(Note to the Borrower: In the event that communications systems are part of this procurement, the Borrower is referred to the appropriate sections of the following Bulletins:

- 66-11 Guide Specification for Microwave
 Communications System
- 66-12 Guide Specification for Power Line
 Carrier System
- 66-13 Guide Specification for Mobile Radio
 System

However, if the communications requirements can be satisfied by existing facilities or facilities subject to a separate procurement, these facilities should be fully described, as directed in Section 4.0 of this Guide Specification.)

8.0 DESIGN GOALS

8.1 Introduction

The Offeror shall design a system that meets all the objectives of the Purchaser as defined in these specifications. Some degree of compromise is possible in the interest of optimized performance, cost or both. However, the justification for any deviation from these specifications shall be the burden of the Offeror. In any event, currently existing circumstances, operating and growth characteristics shall form the system requirements and guide the Purchaser in any or all engineering decisions.

8.1.1 System Availability

The Purchaser expects a system availability of 99.8%, or better to be achieved for all critical functions. Lesser availability figures may be acceptable for equipment or functions not directly related to control and data acquisition.

The Offeror shall state the availability achievable with his proposed system and how this availability will be achieved.

8.1.2 Redundancy and Backup

The proposed LC system shall be designed so that a single component failure anywhere in the system will not result in the loss of a critical function. If a space component is required to maintain high system availability, and it can be useful in supporting a noncritical function, it shall be incorporated as an on-line component.

8.1.3 Reliability and Security

The proposed LC system shall have strong reliability and security characteristics. For the purpose of this specification, reliability is defined as the readiness of the system to operate whenever circumstances and the dispatcher require it to operate. Security is defined as a characteristic which prevents the system from operating except at the expressed and verified command of a dispatcher or the built-in logical functions of its program. Both characteristics shall be incorporated into the hardware and software of the system proposed.

8.1.4 State-of-the-Art Design

Proven state-of-the-art shall be incorporated in all phases of the system design. The design approach taken shall not result in difficult maintenance problems nor involve developmental work, or the proposal of an experimental system. Rather, the design approach should be to improve monitoring and control capabilities of the system and forestall premature obsolescence.

8.1.5 Man/Machine Interface

The proposed control system is primarily a dispatcher tool. Innovative techniques which improve the efficiency, ease, and speed by which equipment may be monitored, dangerous conditions pinpointed, control actions forwarded, and monotonous activity relieved are encouraged.

8.1.6 Conservation of Manpower

Operational use of manpower is a prime requirement of system design. The proposed system should require a minimum number of personnel for daily operations, updating, and maintenance. In evaluating system concepts, the effective use of dispatcher manpower will be given prime consideration.

8.1.7 Maintainability

The proposed system should be designed for ease of maintenance. Parts and modules should be readily accessible for repair or replacement and diagnostics should be supplied.

8.1.8 Expandability

Hardware and software should be capable of easy expansion to accommodate system growth over the life of the system. The system design should anticipate increased requirements in main and auxiliary memory, I/O channels, and additional peripherals for logging, plotting, display, or data collection.

8.1.9 Life Span

The system design goal for useful life should be at least twelve years. Availability projections and estimates should be presented in terms of the useful system life. Spare parts should be available throughout the useful system life.

8.2 Standards

The design, construction and performance of all hardware and software furnished to this specification shall conform to the latest applicable standards as follows:

- ° Institute of Electrical and Electronic Engineers (IEEE)
- ° National Electrical Manufacturers Association (NEMA)
- ° American National Standards Institute (ANSI)
- ° Electronic Industry Association (EIA)
- ° International Electro-Technical Commission (IEC)
- ° CCITT Recommendations

In case of conflict between these specifications and any of the above authorities, these specifications shall prevail. All conflicts shall be referred to the Purchaser for resolution.

9.0 SUPPORTING SERVICES

9.1 Introduction

The Contractor shall be responsible for the system operation and maintenance through the final acceptance demonstration. The Contractor shall develop a transition plan to transfer system operation and maintenance over to the Purchaser in an orderly manner.

9.2 Documentation

Documentation shall be provided which describes the system and interfaces in support of installation, testing, system activation, operations, and maintenance. Documentation shall include, but not limited to, that which is specified in the following paragraphs.

9.2.1 Hardware Documentation

Documentation shall be submitted for approval for all hardware showing the mechanical and electrical characteristics of equipment furnished. Details shall be sufficient to allow the Purchaser to design and plan for all facilities to which the system must interface.

A hierarchy tree and index shall be established to include:

- ° System block diagrams showing the central control, remote terminals, communication paths, and information data flow.
- ° Master station functional block diagram showing the relationship between all installed equipment.
- ° Hardware layout and assembly drawings showing equipment arrangement, configuration, and dimensions of each piece of equipment. Sufficient detail shall be provided so that all draw-out units and plug-in modules and parts can be located.
- ° Schematics for use in defining system operational modes and functions.
- ° Control Station Cable Drawings indicating interconnect cabling between all equipment items. This drawing may be functionally arranged to show power cabling, communication cabling and interconnect cabling. Cable lengths and sizes shall be clearly depicted to permit the Purchaser to verify placement of conduits.

- ° Control Station External Connection Drawings shall be provided to indicate power, communication, and other similar connection points to the control station equipment.
- ° Configuration (Rack Face) Drawings which show the physical size of each panel and mounting provisions. It shall be possible from this drawing to locate supplemental drawings of the interposing relay and terminal block arrangements as well as the circuit card schematics and assembly drawings.
- ° Cable Drawings which shall illustrate connections from printed circuit cards to power supplies and external connection assemblies.
- ° External Connection Drawings shall be provided to indicate power, communication, control outputs, indication inputs, and telemeter inputs and outputs to be found on the external connection terminals or pins. Standard internal logic drawings and schematics, power supply schematics, etc., which will aid in understanding the operation of the equipment shall also be supplied for review as required by the Purchaser. Any non-standard logic drawings, etc., which are provided for equipment designed to meet the requirements of this specification must be submitted for approval.
- ° Site preparation, installation drawings and procedures. Includes: power, grounding and environmental requirements, cable routing, safety precautions and equipment handling, procedures for mechanical assembly of consoles and racks, list of installation tools to install each piece of equipment, etc. Drawings shall conform to the MIL-D-1000 or equivalent with respect to drawing sizes and title blocks. One reproducible copy (Mylar, or equivalent) shall be submitted.

9.2.2 Software Documentation

Software documentation shall provide a comprehensive and detailed description of all software necessary for the operation and maintenance of the system. It shall describe system overall functions, subsystems, data files and tables, executable modules, external macros, equate files, libraries, and procedures.

Software shall be modular and provisions made for updating a module without reassembling the entire program. Linkage conventions shall be standardized and well documented. A program listing with comments does not in itself constitute a documented program.

The software acceptance test procedure shall define what constitutes acceptable software performance, and how each software package is to be tested to assure proper operation and conformance to specification requirements. The test reports shall document the results of each software test performed.

The users manual to be provided shall contain, as a minimum:

- ° Description of the overall software organization
- ° Narrative description of each program
- ° Instruction language, data format, and coding
- ° Program explanatory material such as macro and micro flow charts, logic, and cross-referencing
- ° File input and output requirements
- ° Storage maps
- ° Interfaces to other programs
- ° Hardware requirements
- ° Supporting program requirements
- ° Program constraints
- ° Special features and related materials
- ° Variable cross reference tables

9.2.3 System Operation and Maintenance Manuals

The manuals to be supplied shall provide instructions for system operation, preventive maintenance, troubleshooting, and repair. Manuals should cover the following subject areas:

- ° Processor subsystem operation and maintenance
- ° Data acquisition and subsystem operation and maintenance
- ° Man-machine subsystem operation and maintenance
- ° Software control subsystem programming manuals and maintenance
- ° System operator procedures
- ° Standard equipment

Good commercial writing and editorial practices shall be adhered to in the preparation of all manuals. The manuals should contain the following general topical structure:

- ° System Concept, Function and Interface
 - General description of system
 - System function and modes
 - System interfaces
 - System theory of operation
 - Supplemental system data and drawings
- ° Subsystem Concept, Function, and Interface
 - General description of subsystem
 - Subsystem functions and modes
 - Subsystem interfaces
 - Subsystem installation details
 - Subsystem theory of operation
 - Subsystem maintenance procedures (as applicable)
 - Subsystem equipment configuration

Equipment manuals
Repair parts identification
Test equipment requirements
Supplemental subsystem data and drawings

9.2.4 System Design Specification

During the initial design phase, the Contractor shall develop a detailed design specification which will become the baseline for the hardware and software systems configuration and performance to be delivered in the course of the contract. The design specification document shall contain, as a minimum, the following:

- ° Description and configuration of the system and identification of deliverable hardware and software subsystems
- ° Description of deliverable documentation
- ° System performance of both hardware and software subsystems
- ° Overall test and performance demonstration plan, including the level of tests to be performed to assure the system meets the stated performance values
- ° Detailed description of system interfaces

9.2.5 Document Changes

Documents shall be identified by number. Changes and revisions shall be appropriately indicated on the face of the drawing by a change sheet in the front of the document. The information on the drawing or change sheet shall identify the change number, date, and subject of change, location of change, requesting and/or approving document, and authorizing person. Actual revisions to drawings or document pages shall be marked or otherwise identified for ease of location.

The Supplier shall be responsible for maintaining change control over the delivered document set for a period which extends through the warranty time. This shall include all corrections due to hardware changes and document inaccuracies or deficiencies determined during usage. Changes to published documents shall be made by substitution of corrected pages or drawings for the incorrect pages or drawings. A method of document control shall be established to control document revisions. Changed pages shall be suitably marked for date of change and areas on the pages that were changed.

9.2.6 Final documentation

Final documentation shall reflect the system as delivered and installed and shall be furnished at the time of system acceptance tests. Other documentation shall be delivered at mutually agreed upon milestones. The following quantities and types of documentation shall be delivered:

- ° Design Specification - _____ copies
prior to contract signing
- ° Preliminary and Approval Documents -
_____ sets prior to design review
meetings
- ° Test Procedure and Test Report Documents -
_____ sets
- ° Master Station Hardware Documents -
_____ sets
- ° Remote Terminal Unit Documents _____
sets
- ° Software Documents - _____ sets
- ° Operators Manuals - _____ sets
- ° Maintenance Manuals - _____ sets

9.3 Training

The Offeror shall submit a training program detailing individual training courses as follows:

- ° Duration
- ° Location
- ° Qualification of Instructors
- ° Objectives
- ° Prerequisites
- ° Content
- ° Outline
- ° Training materials (handouts)
- ° Audio-visual aids
- ° Special equipment, tools, etc.
- ° Ratio of classroom-to-laboratory
experience

The basic courses to be considered in the training plan are:

- ° Power System Operation - The instructions
of how to use the consoles, and other
man-machine equipment in the control room

- ° Processor System Operation - The instruction of how to operate the processor system, system failover, restart the system, and operation of peripherals
- ° Processor and Peripheral Maintenance - The instructions of how to maintain, troubleshoot, repair, and adjust the equipment supplied
- ° System Hardware Maintenance - The instruction of how to maintain, troubleshoot, repair, and adjust the remainder of the hardware supplied at the system operations center including such items as monitors, display drivers, printers, console devices, interface logic backup devices, communications equipment, video hard copies, etc.
- ° Maintenance - The instruction of how to maintain, troubleshoot, repair (at a module/card level) and adjust the remote equipment using their associated test sets
- ° LC Software - The instruction of how to efficiently use and program the main frame supplied software utilized and supplied with the system, including the real-time operating system, assembly languages, programming, instruction set, loaders, assemblers, compilers, macro language and usage, higher order languages, machine functions and control machine services, system build, program debugging, etc.
- ° System Software - The instruction of how to efficiently use and maintain the system software supplied as part of the system by the Offeror, including communications software, report generation, display generation, data base, display generation and change, failure detection software, etc.
- ° Application Program Software - The instruction of how to efficiently use and maintain the applications programs supplied as part of the system by the Offeror

For planning purposes, the following attendance and desired locations should be assumed:

- ° Power System Operation - _____ separate classes of approximately _____ men each at _____
- ° Computer Operation - _____ separate classes of approximately _____ men each at _____
- ° System Maintenance - _____ series of classes for _____ men at _____
- ° Remote Equipment Maintenance - _____ classes for approximately _____ men at _____
- ° System Software - _____ series of classes for _____ men at _____

9.4 Maintenance Plan and Spare Parts

9.4.1 Maintenance Plan

The Offeror shall submit a maintenance plan and a recommended parts list for spare provisioning. The plan shall develop the philosophy and detail the procedure for transfer of the maintenance responsibility over to the purchaser. This transfer shall be coordinated with the training plan.

9.4.1.1 Initial Responsibility

The successful Contractor shall maintain the installed equipment from the time of equipment installation to the time of system acceptance. Maintenance shall be such as to maintain equipment to the performance levels as specified within.

9.4.1.2 Maintenance Service

If the Purchaser so elects, a maintenance contract shall be developed to extend maintenance for a period of one year from the date of system acceptance. During this period, the system shall be maintained at a level of performance as specified herein. At the termination of the first year's contract, the Contractor shall conduct tests, set levels, and correct deficiencies as required to establish performance level of the system to the specifications contained herein. Test procedures as developed for the initial system tests shall be used and results documented.

The Contractor shall keep accurate records of all maintenance performed on each piece of equipment identified

by serial number, including routine or preventive maintenance and emergency repairs, and shall make all records available for inspection by the Purchaser or his designee at any time upon reasonable request.

9.4.2 Spare Parts and Test Equipment

9.4.2.1 Spare Parts and Modules

A recommended spare parts list for the first year of operation on the system shall be provided. The spare parts list shall include prices of the individual modules, sub-assemblies, or spare parts as itemized and the total spare parts cost shall be given as required in this specification.

Parts, modules and test equipment to be recommended by the Offeror, but not manufactured by him, shall be indicated as such, and the manufacturer of the item stipulated. Common parts, such as transistors, diodes, etc., that are available from more than one source shall be shown as such and the manufacturer's name will not be required.

The unit price of each item of Offeror-manufactured test equipment shall be shown, indicating any discount advantage obtained by purchasing the test equipment from the Offeror at the time the system is ordered.

Spares for the equipment shall be recommended at the module level of repair and maintenance. This shall include sub-assemblies, modules and plug-in units.

Facilities available for return of units, subsystems, subassemblies and modules to the manufacturer for repair shall be described by the Offeror. The turnaround time, for shipping the unit in for repair and return, shall be stated by the Offeror.

Spare parts and modules shall be available for _____ years after acceptance of the system by the Purchaser.

9.4.2.2 Test equipment

A list of test equipment required for maintenance of the proposed system shall be provided. It shall indicate the suggested minimum amounts and types of equipment required for proper maintenance. In addition, test equipment should be recommended to perform complete equipment alignment, testing and repair. If test equipment is of other manufacture than by the Offeror, it shall be so indicated.

The number of sets of special tools and test equipment required is as follows:

° Controller Subsystem _____ sets

Control Station	_____	sets
Remote Stations	_____	sets
° Man/Machine Interface Subsystem	_____	sets

The Offeror shall provide a complete list of tools and test equipment (including prices) in his response. Purchaser reserves the right to make final selection of these items.

10.0 PROJECT IMPLEMENTATION

10.1 Project Coordination

10.1.1 Purchaser's Interface

The Contractor shall coordinate with and direct all communication to the Purchaser's Project Manager. The Project Manager shall have complete authority over the project and serve as the Purchaser's representative in all matters relating to the project.

10.1.2 Contractor's Interface

The Contractor shall appoint one Project Manager. All communication by the Purchaser will be directed through the Contractor's Project Manager. Appointment of person(s) other than those candidates designated in the Offeror's Proposal to key project positions shall be subject to Purchaser's approval.

10.1.3 Contractor's Organization

Within _____ days following the contract signing, the Contractor shall describe his general management organization as it relates to project support and control, and the project organization intended to support the project. In his project organization description, he shall indicate all design, implementation and testing areas of the project and their interrelationships. He shall describe the responsibilities of the Project Manager in relation to these areas and his control over their timely scheduling. The Contractor shall also provide a list of all engineering, programming and other personnel to be assigned to the project. The list shall include brief biographical information and the responsibilities to be undertaken by individuals. The Contractor shall notify the Purchaser of personnel changes in the project staff within two weeks of their occurrences throughout the project's duration.

10.1.4 Technical Meetings and Reports

Technical Discussion Meetings shall be held on an as-needed basis between the Purchaser and the Contractor. The meetings may be called by either party.

For each meeting, a proposed agenda, mutually agreeable to the Contractor and the Purchaser, shall be prepared and exchanged in advance. The agenda will serve to indicate which project members should be present at each meeting.

The Contractor shall submit to the Purchaser a Meeting Report within _____ days following completion of each Technical Discussion Meeting.

10.1.5 Monthly Reports

By the _____ day of each month during the life of the contract, the Contractor shall submit a progress report to the Purchaser. This report shall contain an updated Project Schedule (reflecting any advances or slippages incurred), a tabulation of slippages (with their causes and projected effect on the total Schedule), problem areas (including whether they were or were not solved), major decisions made, and major tasks performed during the previous calendar month. It is intended that the monthly report will be of major assistance in detecting any potential problem areas as far in advance as possible.

10.1.6 Documentation Review and Approval

The System Documentation required in this Specification shall be submitted by the Contractor to the Purchaser for general review and approval in accordance with Table 10.1 to demonstrate fully that the furnished system will conform to the Contract. Any assembly or coding done prior to the general approval of the associated documentation will be at the Contractor's risk. Copies of each piece of documentation shall be forwarded as soon as possible for preliminary review and use. Approval by the Purchaser is for the purpose of ascertaining conformance to the Contract and does not relieve the Contractor of his responsibility to the Contract. The Purchaser may require up to thirty days after receipt of each piece of documentation for the examination and approval of such documentation unless otherwise noted in this Specification. The Software Design Document may require up to _____ weeks for review.

10.2 Schedules

10.2.1 Project Schedule

The Offeror's response shall include a schedule covering all project activities from the signing of a contract to the completion of field acceptance tests. Table 10.2 illustrates the Purchaser's expectations.

A simplified PERT/CPM chart shall be used which utilizes a uniform time base along the horizontal axis and clearly shows the relationship (prerequisites) of the various events in the schedule. The Offeror's proposed schedule shall clearly define any and all critical dates for Purchaser activities during document approval, Factory Acceptance Testing and installation.

MONTHS FOLLOWING CONTRACT AWARD

PROJECT TASKS	1	2	3	4	5	6	7	8	9	10	11	12	13	n
HARDWARE PRODUCTION														
SOFTWARE PRODUCTION														
ADVANCE TESTING														
ADVANCE SHIPMENTS														
ADVANCE INSTALLATION														
SYSTEM RACK-UP														
SYSTEM INTEGRATION														
FACILITY ACCEPTANCE TEST														
SYSTEM SHIPMENT														
SYSTEM INSTALLATION														
SYSTEM START-UP														
FIELD PERFORMANCE TEST														
AVAILABILITY TEST														

TABLE 10.1
Preliminary Project Schedule

SYSTEM DOCUMENTATION DELIVERABLES

Description	Copies	Deadline
Meeting Reports		
Monthly Progress Reports		
Prelim. Software Design Doc. (PSDD)		
Complete Software Design Doc.		
Final Software Design Doc.		
Software Design Doc. Updates		
Software Implementation Schedule		
Inventory List		
Control Station Installation Manuals		
Hardware Approval Drawings		
Final Drawings (transparencies)		
Preliminary Dispatcher's Manual		
Final Dispatcher's Manual		
Programmer's Manuals		
Factory Acceptance Test Procedures		
Maintenance Manuals, Control		
Maintenance Manuals, Remote		
Program Tapes or Disk Packs		
Program and Data Base Listings		
Equipment Maintenance & Problem Log		
Data Base Description		
Misc. Software Documentation		
Training Course Outlines		
Factory Acceptance Test Reports		

To support effective monitoring of the project's progress, meaningful and measurable performance milestones shall be scheduled frequently. These milestones shall be defined with the understanding that achievement of a later milestone will not be recognized unless all prior milestones have already been achieved. Bids which do not propose appropriately ordered meaningful and measurable performance milestones will be subject to rejection.

10.2.2 Documentation Schedule

Table 10.2 expresses the scope, schedule, and quantities of the system documentation required by the Purchaser. In recognition of the different system configurations available, the Purchaser may allow exceptions for a limited amount of subdivision and rearrangement of the system documentation.

10.2.3. Software Implementation Schedule

A detailed software implementation schedule supplementing the overall project schedule shall be submitted following the approval of the preliminary software design documentation and shall employ the same simplified PERT/CPM chart format used for the overall project schedule.

10.3 Contractor and Purchaser Responsibilities

The Contractor and Purchaser shall both share in the responsibility of system implementation, including designing, fabricating, integrating, testing and demonstrating the hardware and software.

10.3.1 System Design, Fabrication, Tests, and Delivery

The Contractor shall be responsible for the system's hardware and software design, manufacture, preparation, integration and test.

10.3.1.1 Functional Interface

The Contractor shall be responsible for the functional integrity of all internal and external system interfaces. If required, the Contractor shall make on-site visits to determine interface requirements.

10.3.1.2 Power System Data

The Purchaser will provide all necessary updated system data.

10.3.1.3 Shipping

The Contractor shall be responsible for the packing and safe shipment of all system hardware.

10.3.2 Installation and Integration

The Contractor shall furnish all plans and procedures necessary for the smooth and orderly system installation and integration. The dates of these submissions shall be compatible with the system implementation schedule. The Purchaser will furnish all architectural drawings required by the Contractor to develop the plans and procedures. The Purchaser shall review and approve all plans and procedures prior to performing any installation.

10.3.2.1 Site Preparation

The Purchaser will prepare all sites for the installation of equipment in accordance with Contractor-furnished installation drawings.

10.3.2.2 Control Station Equipment

The Purchaser will perform the physical placement of all equipment as specified in this document.

The Contractor shall provide the technical guidance and supervision for the installation.

10.3.2.3 Remote Equipment

The Purchaser will install all LC equipment in accordance with the procedures and drawings provided by the Contractor.

The Contractor shall provide inspection and approval of all installations prior to system activation and field supervision as required.

10.3.2.4 Transducers

The Purchaser will furnish and install all power system transducers.

10.3.2.5 Power, Lighting, and Air Conditioning

The Purchaser will provide all the required electrical power, distribution and circuit protection.

The Contractor shall provide the requirements for the number of circuits and ratings for circuit breakers and UPS sizing analysis.

The Purchaser will provide general service power, lighting and room and equipment air conditioning.

10.4 Quality Assurance

The Contractor shall perform all quality assurance inspections, tests and reporting in accordance with an approved quality assurance plan. The Offeror shall describe his proposed quality assurance plan in his proposal.

10.5 System Activation

The Contractor shall furnish a system activation plan and procedure. The Purchaser and Contractor will work together to accomplish a secure and smooth system activation and cutover.

10.6 Performance Warranty

The Contractor shall provide a one (1) year performance warranty on the total LC system beginning at the time of final acceptance. The warranty shall provide for the repair, replacement, and rework of any hardware or software items that do not meet the performance and availability requirements of this specification. The warranty shall cover all parts, materials, labor, travel, and subsistence in effecting any and all corrective actions by the Contractor.

11.0 TESTS AND ACCEPTANCE

11.1 General

All materials and hardware to be furnished, and all work to be performed under these specification, shall be subject to inspection and test. All shipments shall be deferred until all inspections and tests have been completed and the Purchaser issues authorization for shipment. Waiving of inspections and tests shall not relieve the Contractor of the responsibility of furnishing a system that meets the requirements of these specifications. The Purchaser reserves the right to require rework and retest of any item or work found not to be in accordance with these specifications.

The Contractor shall implement and maintain, for the duration of the contract, an effective Quality Control and Quality Assurance Program to provide for early detection of actual or potential deficiencies and shall provide for timely and effective corrective action. All deficiencies shall be promptly reported to the Purchaser along with an analysis of the problem and corrective actions taken.

The Purchaser shall have access to in-process work and to inspection records and current inspection procedures.

11.1.1 Test Plans

The contractor shall submit test plans for all factory and field acceptance tests. Test plans shall be approved by the Purchaser prior to the commencement of each test. Test plans shall explain the purpose of each test, define test inputs, specify test procedures, diagram test setup, and define outputs to be achieved. Software test plans shall include a summary of the methods, a list of test cases, and expected results. The Contractor shall submit test plans at least three weeks prior to testing to allow adequate time for review and approval by the Purchaser. Factory tests and availability tests shall not proceed without the prior delivery of hardware and software documentation.

11.1.2 Test Reports

The Contractor shall transmit to the Purchaser all results of factory and field acceptance tests. Each report shall include the purpose and method of the test and a description of any deviations from the previously approved test plan. Test data sheets shall be signed and dated by Contractor's test conductor and Purchaser's witness. Each report shall include test data that is compared with expected results. The data furnished shall demonstrate conclusively that the element under test performed within specification limits during the test.

11.1.3 Unit Design Performance Tests

Each major unit or subsystem shall be tested when fabrication and/or integration has been completed. All tests shall be identified in the system schedule at the outset of this project.

11.1.4 Routine Quality Control Tests

All components and assemblies comprising a subsystem shall be given a routine factory test. These tests shall be documented in accordance with the practices and procedures delineated in the Offeror's Quality Control and Assurance Program described in his proposal. The Purchaser shall have access to the reports upon request. No test plans are required for these routine factory tests.

11.1.5 Factory Tests

Fully integrated systems tests shall be conducted on the Contractor's premises. The purpose of these tests shall be to exercise system hardware and software under simulated conditions prior to shipment.

11.1.6 Preliminary Field Acceptance Test

Following installation of the system, all hardware shall be aligned and adjusted and all test readings recorded in accordance with the Contractor's recommended alignment and test procedure. The Contractor shall report all hardware or components replaced or interchanged since completion of factory tests. The Contractor shall repeat an abbreviated form of the factory tests. A performance test shall also be conducted to verify that correct data interchange is secured over all interfaces and that all hardware and software is fully operational.

11.1.7 Availability Test

After the preliminary field acceptance test has proven the system to be fully operational with a full complement of equipment, a _____ day availability test shall be conducted. This test shall be performed under actual operating conditions and the period of testing shall be for a consecutive _____ days. The period shall be reinitialized after any significant change has been made to the system. If the availability of the system for the test period is equal to or greater than _____%, the test will be considered successfully completed.

If the availability requirements are not met, the test shall be continued until the specified system availability is achieved over any consecutive _____ day period, or until the total test period has exceeded 12 months, at which time the test will be concluded as unsatisfactory. The Purchaser may then elect one of the following options.

- ° Discontinue the use and operation of the system and terminate the contract
- ° Negotiate with the Contractor for an extension of the availability test, with proper compensation by the Contractor to Purchaser for costs incurred by the delay

11.2 Final Acceptance

The Purchaser will accept the system when, in the Purchaser's sole judgment, the following conditions are met:

- ° The purchased system meets the requirements of this specification and all the design documents are subsequently approved by the Purchaser
- ° All required testing has been satisfactorily completed
- ° All required documentation has been delivered

12.0 SPARE PARTS AND MAINTENANCE

12.1 General

This section describes the requirements for spare parts and test equipment for the operation and maintenance of the system to be furnished. Parts, modules and test equipment to be recommended by the Offeror, but not manufactured by him, shall be indicated as such, and the manufacturer of the item stipulated. Common parts such as transistors, diodes, etc., that are available from more than one source shall be shown as such and the manufacturer's name will not be required.

The unit price of each item of Offeror manufactured test equipment shall be shown, indicating any discount advantage obtained by purchasing the test equipment from the Offeror at the time the system is ordered.

12.2 Spare Parts

A recommended spare parts list for the first year of operation on the system shall be provided. The spare parts list shall include prices of the individual modules, sub-assemblies, or spare parts as itemized and the total spare parts cost shall be given as required in this specification. Spare parts or sub-assemblies for the following shall be provided:

- Load Controller
- Load Control Transmitter
- Load Control Switches
- Transmission Equipment
- Battery Equipment
- Man/Machine Interface Subsystem

Spares for the equipment shall be recommended at the module level of repair and maintenance. This shall include sub-assemblies, modules and plug-in units.

Facilities available for return of units, subsystem, sub-assemblies and modules to the manufacturer for repair shall be described by the Offeror. The turn around time, for shipping the unit in for repair, and return, shall be stated by the Contractor.

Spare parts and modules shall be available for _____ years after acceptance of the system by the Purchaser.

12.3 Maintenance Tools and Test Equipment

A list of maintenance tools and test equipment required for maintenance of the proposed system shall be provided. It shall indicate the suggested minimum amounts and types of equipment required for proper maintenance. In addition, test equipment should be recommended to perform complete equipment alignment, testing and repair. If test equipment is of other manufacture than by the Contractor, it shall be so indicated.

12.4 Maintenance and Maintenance Records

The Contractor shall maintain the installed equipment from the time of equipment installation to the time of system acceptance. Maintenance shall be such as to maintain equipment to the performance levels as specified within.

If the Purchaser so elects, a maintenance contract shall be developed to extend maintenance for a period of one year from the date of system acceptance. During this period, the system shall be maintained at a level of performance as specified herein. At the termination of the first years contract, the Contractor shall conduct tests, set levels, and correct deficiencies as required to establish performance level of the system to the specifications contained herein. Test procedures as developed for the initial system tests shall be used and results documented.

Maintenance by the Contractor will be in accordance with these requirements:

- ° Replacement parts shall be at least of equal quality and ratings as the original parts
- ° Any water, oil, dust, or other foreign substance will be removed from the equipment, its parts and attachments
- ° Performance of the equipment will be kept at the level stated in the Purchaser's performance specifications
- ° Routine maintenance procedures prescribed or recommended by the Contractor for his equipment shall be followed
- ° The Contractor shall provide only factory trained and authorized maintenance personnel
- ° The Contractor shall supply comprehensive installation and maintenance manuals as part of this equipment purchase
- ° Service shall be provided on a 24-hour emergency call basis with on-site response within four hours after call

If there is any discrepancy between the maintenance obligations of the Contractor as represented by the standards of maintenance set out herein, the Contractor's Maintenance Agreement, the bid documents, or the proposal, the maintenance

obligations and standards most favorable to the Purchaser shall apply. The Contractor shall keep accurate records of all maintenance performed on each piece of equipment identified by serial number, including routine or preventive maintenance and emergency repairs, and shall make all records available for inspection by the Purchaser or his designee at any time upon reasonable request.

13.0 DOCUMENTATION AND STANDARDS

13.1 Documentation

13.1.1 Initial Deliverable Documentation

Within _____ days subsequent to date of contract award, the Contractor shall furnish for Purchaser approval, a minimum of _____ sets of preliminary systems drawings and documentation consisting as a minimum of the following:

13.1.1.1 A key or index sheets listing in a numerical sequence all drawings and descriptive literature.

13.1.1.2 Rack elevations showing rack dimensions on all equipment units and their location on the racks.

13.1.1.3 _____ operational instruction books, including schematic diagrams for each different type of unit furnished shall be sent with the preliminary drawings to facilitate interpretation and approval of the drawings.

13.1.1.4 Operational block diagrams covering system function, alarm system and signal flow.

13.1.1.5 Manufacturer's assembly and installation drawings for antennas.

13.1.1.6 Communication equipment building physical layouts and structural drawings with dimensions. Included shall be drawings and descriptive data on all equipment included as part of the equipment building.

13.1.1.7 Drawings showing physical mounting details of all equipment and hardware furnished.

13.1.1.8 Details on station and equipment grounding.

13.1.1.9 Detailed building wiring drawings showing wire sizes and runs.

13.1.1.10 Wiring harness drawings and cable running lists for all racks, to include wiring of all plug-in shelf assemblies, showing wiring connections between units on a shelf and inter-rack wiring. Where vendor standard wiring assemblies are used, they shall be marked or otherwise cross-referenced to indicate applicable options and strappings. Units wired but not equipped shall be so indicated. External connections to all racks. All external connections, such as for power, alarm, audio, etc., shall be cross-referenced on the key or indexed sheets.

13.1.1.11 The Contractor shall furnish for approval, within _____ days after the contract award, his proposed system test plan and procedures.

13.1.1.12 The Purchaser will, within _____ days after receipt of prints of drawings and design analysis for approval, forward one copy of each to the Contractor marked with one of the following:

13.1.1.13 Approved: Prints so marked will authorize the Contractor to proceed with the fabrication of the equipment.

13.1.1.14 Approved With Corrections: Prints so marked will authorize the Contractor to proceed with the fabrication of the equipment in accordance with indicated corrections. The Contractor shall make the necessary drawing revisions.

13.1.1.15 Returned for Correction: The Contractor shall make the necessary corrections and revisions on the drawings as indicated and shall resubmit prints for approval. Time required for such revision of drawings and resubmission of prints will not entitle the Contractor to any extension of time.

13.1.1.16 Work accomplished, or materials ordered, by the Contractor, prior to receipt of prints marked Approved or Approved With Corrections As Noted, shall be at the Contractor's risk. Approval by the Purchaser shall not relieve the Contractor of the responsibility for the correctness of the drawings furnished by the Contractor nor for their compliance with the specifications.

13.1.2 As Built Documentation

The Contractor shall furnish, within _____ days after system cutover the following documentation and manuals:

13.1.2.1 _____ sets of Instruction Manuals, covering the Load Control equipment, incorporating, as a minimum the following information:

13.1.2.2 Complete system installation, operating, and line-up instructions.

13.1.2.3 Instructions for each different equipment unit furnished, including operating and maintenance instructions, parts lists, and schematic diagrams.

13.1.2.4 For units not manufactured by the radio equipment supplier, the manufacturer's name and his identifying part number shall also be furnished.

13.1.2.5 Operational block diagrams covering all system functions.

13.1.2.6 One set of Instruction Manuals per station covering the battery chargers, air conditioners if being furnished, and test instruments incorporating the following information:

13.1.2.7 Complete installation, operating, maintenance, and line-up instructions.

13.1.2.8 Complete schematic and wiring diagrams.

13.1.2.9 Complete parts lists.

13.1.2.10 The Contractor shall supply for each site, _____ copies of a certified factory test report. This test report shall contain data and meter readings taken during final factory alignment of equipment. No equipment will be acceptable which has a reading or readings not within the stipulated and agreed upon tolerances listed in the instruction book. The test report shall contain overall system performance data to indicate compliance with all system tests. Three copies of system test reports containing the overall system performance data of the system field tests shall be furnished within _____ days after completion of tests.

13.1.2.11 The Contractor shall prepare a set of "as-built" drawings and submit these to the Purchaser's Engineer for final approval. After final approval, the Contractor shall provide to the Purchaser, one complete set of reproducible drawings and _____ sets of black line copies.

13.1.2.12 The successful Contractor shall be responsible for placing the Purchaser's name and address on the mailing lists of the manufacturers of all items furnished under these specifications, so that the Purchaser may receive all literature and data associated with any design modifications or alterations made by the manufacturers subsequent to the acceptance of the system by the Purchaser, and for a period of _____ years.

13.1.3 Documentation Contents

The documentation shall include all equipment/system maintenance and operations manuals, software programs and maintenance routines, engineering, assembly and installation drawings/documents with index, text plans, test procedures and acceptance test reports.

13.2 Standards

The standards employed by the Contractor in designing, fabricating, installing, testing or documenting the load control system shall be of good commercial practice. Rural Electrification Administration and other governmental standards shall be used wherever possible. The Purchaser's Engineer will determine the standard to be employed where several standards are applicable. If no pertinent standard exists, then the Engineer will establish the standard or standards for the Contractor to follow.

